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AUTHOR Wang, HsingChi A.; Cox, Anne Marshall
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ABSTRACT

This paper looks at two standards documents--the National Science Education Standards (National Research Council, 1996) and the Performance Standards (New Standards, 1997)--to investigate curriculum conceptions included in each document. Eisner's (1985) five curriculum orientations are used as a lens to better conceptualize the messages behind these standards. Eisner described curriculum as developing Cognitive Processes, Personal Relevance, Social Adaptation/Social Reconstruction, Academic Rationalism, and Technology. The authors conclude that not every standard in these documents portrays the same curriculum conception, and that the science education community should specifically determine the purpose of science standards and measurable ways of meeting those standards. They suggest utilizing a combination of the curriculum conceptions described by Eisner to create a new curriculum conception containing the goals of the current standards documents. (PVD)

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Curriculum Conceptions and Science Standards

by
HsingChi A. Wang
and
Anne Marshall Cox

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CURRICULUM CONCEPTIONS AND SCIENCE STANDARDS

HsingChi A. Wang and Anne Marshall Cox

Center to Advance Science Education
Department of Curriculum and Instruction
University of Southern California, Los Angeles, CA

Overview

During the 1990's standards in education have permeated science education literature and been one of the most discussed topics at professional meetings. Several science standards documents have been published during the last four years by various groups and have created some confusion as to the cumulative goals of these projects. In this paper, we would like to look at two standards documents: the National Science Education Standards (National Research Council, 1996) and the Performance Standards (New Standards, 1997) to investigate curriculum conceptions included in each document. Eisner's (1985) five curriculum orientations will be utilized as a 'lens' to better conceptualize the messages behind these standards.

National Standards Documents

Standards in education serve as a framework for designing curricula. According to Longstreet and Shane (1993), educational standards are selective and organized learning content that portrays instructional goals and purposes. These goals and purposes represent the values and needs of the society, focusing on "what" is really expected for students to know and modes of assessing "how well" they know it. Yet, the "how well" is generally left out throughout the history of education. Current initiators of educational standards ensure that both content standards and performance standards have been included (National Research Council, 1996; New Standards, 1997).

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In 1989, the National Council of Teachers of Mathematics (NCTM) released a national mathematics standards document. These standards obtained wide recognition as mathematics teachers' readily endorsed them and led the way for education standards in an array of disciplines, including science. Three national-scale science standards projects were released in response to NCTM's success: Project 2061's Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993), National Science Education Standards (National Research Council, 1996), and Performance Standards for science (New Standards, 1997).

Groups of educators, scientists, and policy-makers who initiated these national standards projects did not intend to generate a national, uniform curriculum. Instead, they designed standards documents to delineate achievable and desirable education directions for designing local curricula in diverse areas of the country. Each document is made available for teachers, administrators, and researchers to serve as visions and foundations for a science curriculum. Bybee (1996) cautions that generating standards is only a first step for science education reform. After consensus about what the standards should encompass, implementing these standards will require a concerted effort by all members of the science education community. Bybee also reminds us that standards are not designed to provide complete programs, practices, and assessments, but to allow experts to interpret and implement dimensions of the standards for planning science programs.

Among the six educational goals in Goals 2000 defined by the National Governors' Association in 1990, the most dramatic goal states that students in the United States will be first in the world in science and mathematics achievement by the year 2000. However, recently released results from the Third International Mathematics and

Science Study (International Association for the Evaluation of Educational Achievement, 1996) indicate that this goal of students being "first in science" would not be met unless a more coherent science curriculum is presented. The TIMSS international study accused math and science curricula in the United States of being too "splintered" with too much material expected to be covered during the course of an academic year. TIMSS suggests that curriculum be written so students receive more depth and less breadth of science content.

Beane (1995) describes a coherent curriculum as one which makes sense as a whole and is unified and connected. He describes an incoherent curriculum as one which is disconnected and fragmented. Fortunately, recent reform endeavors for preparing standards documents is the first step in providing a vision for designing a standard-based curriculum that will result in desirable students outcomes.

Curriculum Conceptions

Eisner and Vallance (1974) and other curriculum theorists discussed several conceptual orientations of the philosophies of schooling. Different conceptions place a different focus on schooling and generate different curricula. Therefore, to construct a standards-based curriculum, curriculum designers must understand what curriculum conceptions are portrayed within the standards. Eisner (1985) synthesized five conception orientations, and described curriculum as developing Cognitive Processes, Personal Relevance, Social Adaptation/Social Reconstruction, Academic Rationalism, and Technology. Each of Eisner's five curriculum orientations differs according to its principle ideology and purpose. Until we determine the purpose of schooling, and more specifically, the purpose of science instructions, it is difficult to endorse any science

standard document. A description of each conception and its application to schooling is described in relation to actual practice.

Cognitive Processes is a curriculum conception seeking to develop a repertoire of cognitive skills that are applicable to a wide range of intellectual areas. School subjects are integrated for strengthening students' intellectual abilities and preparing them to utilize important process skills within various subject areas. Longstreet and Shane's (1993) description of the 'Process-as-content Knowledge-centered' curriculum includes a similar ideology to Cognitive Processes. The instructional aim of both Process-as-content and Cognitive Processes is to learn through discovering big ideas and concepts instead of reinforcing a series of facts on students. Hands-on learning, science as inquiry, or discovery learning are all examples for a Cognitive Processes curriculum. Specifically, the content in biology or physics would be considered less important than the abilities to infer, hypothesize, analyze, deduce, or apply. Across disciplines, these process skills are commonly utilized to facilitate students' learning.

Self Relevance in curriculum views education as an enabling process that provides a means for personal liberation and development. The conception believes that what is taught in the schools should provide individuals to discover or solve things that relates to their personal interests. Self Relevance is evident in child-centered curricula seeking to enrich experiences by provided developmentally appropriate instruction. Applying this conception to the development of middle school students, one must understand both physiological and psychological changes happening within these students and plan curriculum accordingly. Self relevance would also be valued in a

culturally-centered curriculum where one single cultural group is not viewed as superior or dominant over the others.

Social Adaptation and Social Reconstruction conceptions support education as relevant for both individual and societal needs. A similar ideology, the Society-oriented curriculum described by Longstreet and Shane (1993), believes that the task of schooling is to provide learners with more than academic achievement by acknowledging and valuing the individual's personal experiences with their environment. Educational reform after the launch of the Soviet's Sputnik generated curriculum projects to help our students meet society's needs in space. Projects like Science: A Process Approach (SAPA), and Elementary Science Study (ESS), and Science, Technology, and Society (STS) are curriculum examples developed in response to the dynamic societal needs.

Academic Rationalism presumes that schooling cannot provide learners with everything, but can "cultivate the child's intellect by providing him or her with opportunities to acquire the most powerful products of man's intelligence" (p. 12) (Eisner & Vallance, 1974). Disciplines that contribute to a traditional core curriculum such as Literature, English, Science, Social Studies, or Mathematics are important for learning about past studies and noted works. Academic Rationalists believe that curriculum must prepare learners to exercise reasoning capacities through the content-input from these important disciplines. Content is presented as a fixed body of facts, principles, and definitions through formal modes of instruction such as lecture or text.

Curriculum as Technology focuses more on the function of a curriculum. Schooling is viewed by educational technologists as a complex system that can be analyzed into established components resulting from research findings. Instructors utilize

these research findings for better schooling. Examples of Curriculum as Technology result from such research findings that include the behaviorists' Stimulus-Response (S-R) Reinforcement Model, social psychologists' Modeling Theory, and the Integrated Computer Simulation of real-problems.

Technology conception does not emphasize quantity or quality of the classroom hardware, but on the manner of how to transform available resources into well-planned instruction. Teachers, who are aware of the responses, reinforcement and stimuli interactions from the S-R model, may apply it on their teaching strategies. Instructors who apply cooperative learning research, might adopt group learning strategies as part of students learning experiences.

Conceptualizing the Standards Project

In the process of conceptualizing two standards projects, the National Science Education Standards and the New Standards, we learned that not every standard in these documents portrays the same curriculum conception. In fact, several curriculum conceptions reside within these standards documents. There is a sense of non-commitment to any one of the conceptions; nevertheless, some conceptions are better represented than others. Social Relevance and Social Adaptation conceptions are prevalent in each document as is the Personal Relevance conception. Examples from each of the documents are presented in Tables 2 and 3.

Questions posed by Beane (1995) in his inquiry into a coherent curriculum may continue since these documents contain varied curriculum conceptions. His questions include: Should the purpose of school be to control and manage what children learn? Or should the purpose of school engage students in critical inquiring about knowledge and

its relationship to their own experiences. It is possible that an 'and' should separate these questions instead of an 'or'. Content contained within each document indicates that there should certainly be management in reference to what students learn and at what grade level students should learn it. In addition, it is clear that each document advocates students engaging in real-life problems and making critical decisions about knowledge they gained. Therefore, we ask a different question: Is it possible for science educators to 'have their cake and eat it too'? This would indicate that yes, students should be required to obtain certain skills and learn specific content at various grade levels. In addition, students should also have opportunities to seek depth in content areas by critically analyzing knowledge and applying this knowledge to real-life scientific endeavors.

If our goal is to educate students in the United States to be 'first in science' in comparison to students of other industrial nations, it is not possible to continue an incoherent vision resulting in a fragmented curriculum. It is more important than ever that the science education community specifically determine the purpose of science standards and measurable ways of meeting these standards. Utilizing a combination of curriculum conceptions described by Eisner (1985) to create a new curriculum conception containing the goals of these current standards documents, would pave the way for more effective and globally competitive science instruction as we enter the 21st century.

Table 2: NRC: National Science Education Standards

The Content Standards	Curriculum Conception(s)	Instructional Applications
"...student understanding is actively constructed through individual and social processes." (p28)	Social Adaptation & Social Reconstruction and Self Relevance	individualized instruction & cooperative learning strategies
teachers plan an inquiry-based science program (Standard A)	Cognitive Processes	students ask questions & seek answers
design curricula to meet experiences of students (Standard A)	Self Relevance	use concept maps/other strategies for assessing prior knowledge
develop a year-long framework & goals for students (Standard A)	Curriculum as Technology	holistic planning
teacher encourages & models science skills & inquiry (Standard B)	Cognitive Processes	teachers explore with students or teachers initiate discrepant events
nurture collaboration among students about scientific ideas (Standard B, E)	Social Adaptation & Social Reconstruction	Socratic dialogue or critical discourse on history of science
teacher identifies, offers, & uses various resources inside/outside of the school	Curriculum as Technology	interaction with community through - projects - experiments

Table 3: New Standards: Performance Standards

The Content Standards	Curriculum Conception(s)	Instructional Applications
understand conservation of energy; transfer, heat. (Physical Science Concepts)	Academic Rationalism	explain the difference between temperature and heat
big ideas & unifying concepts like systems, change (Scientific connections and applications)	Cognitive Processes	compare the form & function of a robot & human hand
formulate & revise explanations, & models based on evidence & logical argument (Scientific Thinking)	Cognitive Processes, Social Adaptation & Social Reconstruction, and Self Relevance	determine if the evidence in the summary data chart of the <i>Consumer Reports</i> substantiates the "Best Buy" of what you want to purchase
acquire information from print, electronic, & visual sources, including the Internet (Scientific Tools & Technologies)	Curriculum as Technology	use the Internet to obtain current information on a rapidly changing scientific topics such as 'Genome Project'
critique published materials including popular & academic sources (Scientific Community)	Social Adaptation & Social Reconstruction	critique <i>Time Magazine</i> article which reports on issue of S&R fund raising.

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